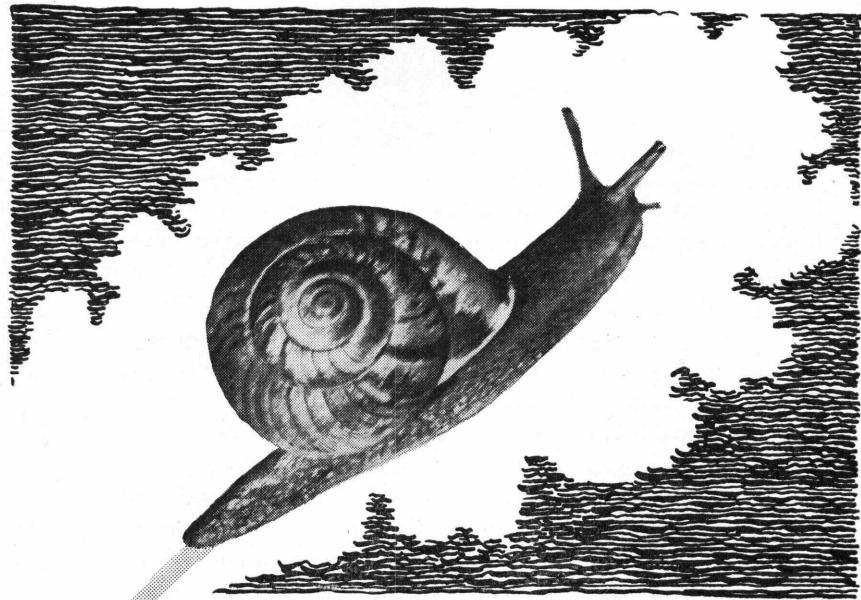


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# LAND SLUGS AND SNAILS

and Their Control

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No. 1895

U. S. DEPARTMENT OF AGRICULTURE

**THIS BULLETIN** describes the development and habits of some injurious snails and slugs and gives measures that may be used to rid the premises or grounds of these oftentimes destructive and undesirable tenants.

The favorite haunts of slugs and snails are damp or moist places under or near accumulations of decayed vegetation or rubbish, piles of old boards, bricks, and stones, and dense, low-growing vegetation; they are also found in basements and drain pipes and on rough stone walls and well walls.

This indicates the importance of keeping the basement and spaces beneath porches dry and the garden and greenhouse clean and free from rubbish, old boards, bricks, and like materials, which offer protection to the pests. Pointing-up foundation walls and the walls of dug wells is also an aid in control.

When slugs or snails have become established, it is recommended that a poisoned bait consisting of 1 ounce of metaldehyde to 3 pounds of wheat bran, slightly moistened, be scattered over the infested area or, in the case of mushroom houses, placed in many small piles along the edges of the beds. Sometimes fairly good control can be obtained by the use of a bait consisting of 1 part of calcium arsenate in 16 parts of bran, moistened, and scattered about a garden or other places where it may be used with safety. Both metaldehyde and calcium arsenate should be used in the bait when the humidity is continuously high.

When only a few slugs or snails are present, they may be collected by hand picking at night, with the aid of a lantern or flashlight, and destroyed; or they may be killed in the daytime in their hiding places beneath boards or rubbish.

This bulletin supersedes Farmers' Bulletin No. 959, The Spotted Garden Slug.

Washington, D. C.

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# LAND SLUGS AND SNAILS AND THEIR CONTROL

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## ECONOMIC IMPORTANCE OF SLUGS AND SNAILS

SLUGS AND SNAILS are of considerable economic importance through their depredations in gardens, orchards, greenhouses, and mushroom beds. They are also very annoying to householders through their presence in cellars, around foundations, on walks, and in wells. The fondness of certain slugs for fungi makes them serious pests in mushroom houses, once they have gained access. In greenhouses, slugs and snails attack the young seedlings and the more succulent parts of plants. They leave a trail of mucus over such plants and over other things that are not actually attacked, thus making them unsightly and, in the case of ornamentals, reducing their sales value. In gardens these creatures are frequently abundant, causing serious losses through their attacks on seedlings, flowers, and vegetables. Celery in the beds during the bleaching process is often severely injured by slugs. In these cases the animals nibble here and there, rendering unmarketable far more of the celery than they eat. Potatoes, cabbages, and other produce commonly stored in damp, cool cellars are also subject to attack. Certain snails have been reported as injurious to trees in citrus groves in the United States. In some localities privet and other hedges have been kept in a state of partial defoliation for years by the feeding of snails.

## GENERAL DESCRIPTION

Snails are usually of some shade of gray, but their shells vary from nearly white through brown to nearly black and are often variously ornamented with stripes or mottlings of contrasting colors. The body of a snail consists of the head, neck, visceral hump, tail, and foot. The head bears two pairs of tentacles, or feelers—a large pair above, upon which the eyes are borne, and a smaller pair below, which are used for smelling. The mouth is in the center of the head,

<sup>1</sup> Mr. Davis died January 4, 1942.

below the lower pair of tentacles. Below the mouth is the opening of a large mucous or slime gland. The visceral hump, containing most of the internal organs, is contained in the shell. The shell is secreted by the mantle, which forms a fold where the shell joins the body, or "foot," of the snail. Under the edge of the mantle, on the right side, is the breathing pore, and immediately back of this is the anus. The foot contains mucous glands and the muscles by which the animal crawls. When disturbed, the entire animal may withdraw into the shell.

Slugs are essentially the same as snails in general structure, except that they have no external shell or visceral hump, the mantle being a smoother area occupying a forward fourth or third of the back. Slugs range in length from  $\frac{1}{4}$  inch to 8 or 10 inches, depending on the species and the age of the individual. They vary in color from whitish yellow through various shades of gray to black, usually more or less mottled or marked with darker shades.

Both snails and slugs have a definite mouth, which is equipped with a horny file, or radula, with which they rasp away the substance to be eaten.

### SOME DESTRUCTIVE SLUGS AND SNAILS

Thirty-two species of slugs and several hundred species of snails have been recorded in the United States. Of the many species occurring here, however, only a few are of economic importance, and these are principally introduced ones. The native snails and slugs are solitary in habit, whereas the introduced species are gregarious or colonial and, by building up enormous populations over limited areas, cause great damage.

The most important slugs of our gardens, wells, cellars, and greenhouses are three introduced species, the spotted garden slug (*Limax maximus* L.) (fig. 1), the tawny garden slug (*L. flavus* L.), and the true garden slug (*Deroceras agrestis* L.).

The spotted garden slug varies in color from a more or less yellowish gray or brown, mottled with black, to a uniform dark gray and black. Usually three uninterrupted rows of black spots extend from the mantle, or shieldlike covering, on the fore part of the back and sides to the hind end of the body. The mantle is yellowish with black spots. This is the

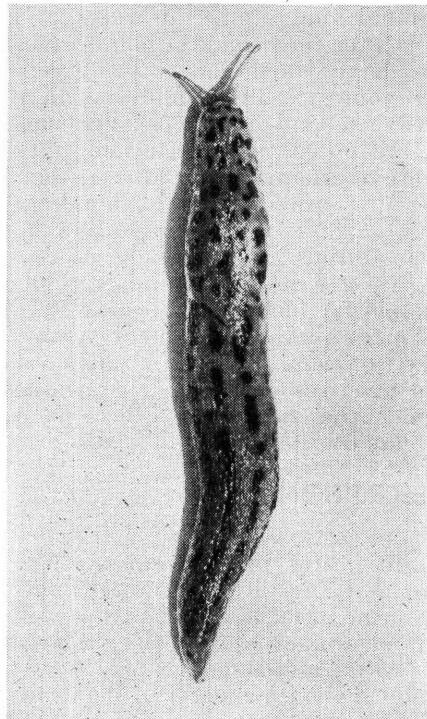


FIGURE 1.—The spotted garden slug, full-grown. About one-half natural size.

largest of the three slugs, and sometimes it attains a length of 7 inches, although the individuals usually found range from  $1\frac{1}{2}$  to 4 inches in length. As a rule the smaller individuals are uniform in color.

The tawny garden slug is a smaller species, rarely attaining a length of 4 inches. It is distinguished from the spotted garden slug by its more uniform tawny or yellowish color with faint lighter spots, by the tawny yellow shield, and by the bluish tentacles.

The true garden slug is a very small species, averaging about  $\frac{3}{4}$  inch in length and rarely attaining  $1\frac{1}{2}$  inches. Its color ranges from uniform whitish through pale yellow, lavender, purplish, and nearly black, with mottlings and specklings of various shades of brown. Because of its small size and inconspicuous coloration this slug can creep into very small cracks and crevices and, thus hidden away, may be transported elsewhere or escape detection and destruction to a greater extent than the larger species.

Of the many species of snails, only a few are of economic importance. The most important are the brown garden snail (*Helix aspersa* Müller), the banded wood snail (*Cepaea nemoralis* L.), the white garden snail (*Theba pisana* Müller), the subulina snail (*Subulina octona* Brug.), and four species of cellar or greenhouse snails—*Oxychilus cellarium* (Müller), *O. lucidum* (Drap.), *O. rogersi* (Woodward), and *O. alliarium* (Müller).

Snails (fig. 2), unlike slugs, are differentiated by the shape, sculpturing, and markings of the shell, the animals themselves being usually grayish.

The brown garden snail is found locally in many parts of the Southern States. Its shell may attain a diameter of  $1\frac{1}{4}$  or  $1\frac{1}{2}$  inches. The coil is elongate, so the length is nearly or quite equal to the diameter. The color pattern is brown, with a mottling of yellow forming irregular longitudinal and transverse striping. The surface of the shell is covered with fine wrinkles.

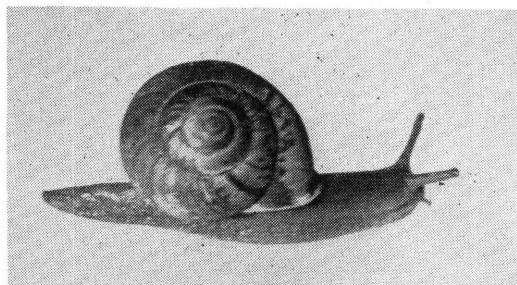


FIGURE 2.—Snail, full-grown; about natural size.

The banded wood snail is found in flower gardens in parts of the South. The shell may reach an inch or more in diameter and is very conspicuous, being light yellow, usually with longitudinal striping of chocolate brown.

The white garden snail has a white shell, usually with irregular darker mottling forming irregular stripes. This snail is of economic importance in some parts of California. It is one of the species used as food in parts of Europe.

The subulina snail is a small species found in greenhouses. It is easily recognized because the grayish shell is very elongate and pointed, so the length is greater than the diameter. Being small, it is easily transported to other greenhouses, and a further danger lies in the fact that upon arrival these snails usually have eggs ready to lay.

The four species of greenhouse or cellar snails of the genus *Oxychilus*

are similar in appearance, the shell being a uniform gray or brown, with a very flat coil attaining about one-half inch in diameter. These snails are widely distributed in greenhouses throughout the United States. They are found in cellars also, preferring dark, damp places in which to live.

### DISTRIBUTION

As has been stated, the most important snail and slug pests are those which have been introduced into this country. Just what countries they came from and when and how they first arrived are not definitely known, but some of them have been here for more than 70 years. In general, these species are most common along the Atlantic and Pacific seaboards, although not uncommon inland. They may easily be transported in the egg or young larval stages in or on potted plants, soil, rocks, and produce. In at least one case, that of one of the edible snails, the species is said to have been introduced deliberately for rearing as food.

### FOOD PLANTS

There are few plants that are not attacked at times by some slugs or snails. Mushrooms (fig. 3), stored potatoes, shrubbery, citrus trees, flowers (fig. 4), leafy vegetables, and forage and cover crops are all subject to injury, especially the succulent growth or the seedling stage.

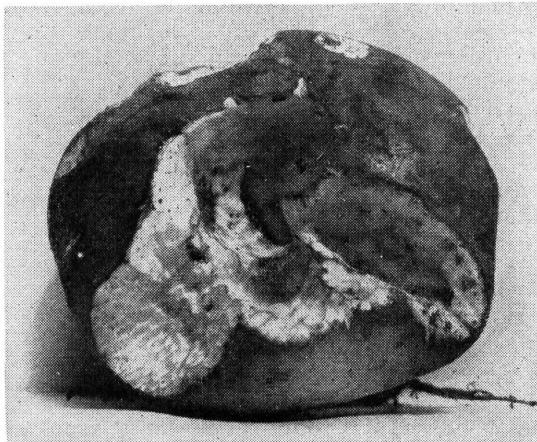


FIGURE 3.—Work of slugs upon a mushroom.

### HABITS

Snails and slugs are mainly nocturnal, but they come out of their hiding places and feed in the evening or on dark days. Their favorite hiding places are under old decaying boards and logs, under board walks, in cellars, creameries, and springhouses, in rock piles, along hedgerows, and beneath damp refuse. Snails are less particular in this respect than slugs, as they have the power, when confronted with unfavorable living conditions, of sealing the opening of the shell with a mucous sheet, the operculum, which soon hardens to a leathery texture. The snails then become dormant, and some may exist

thus for as long as 4 years. When conditions again become favorable, the "door" of the shell is rasped away, and the snail resumes its normal activity.

In winter snails and slugs pass the time in sheltered situations, although in the warmer parts of the country they are active at times.

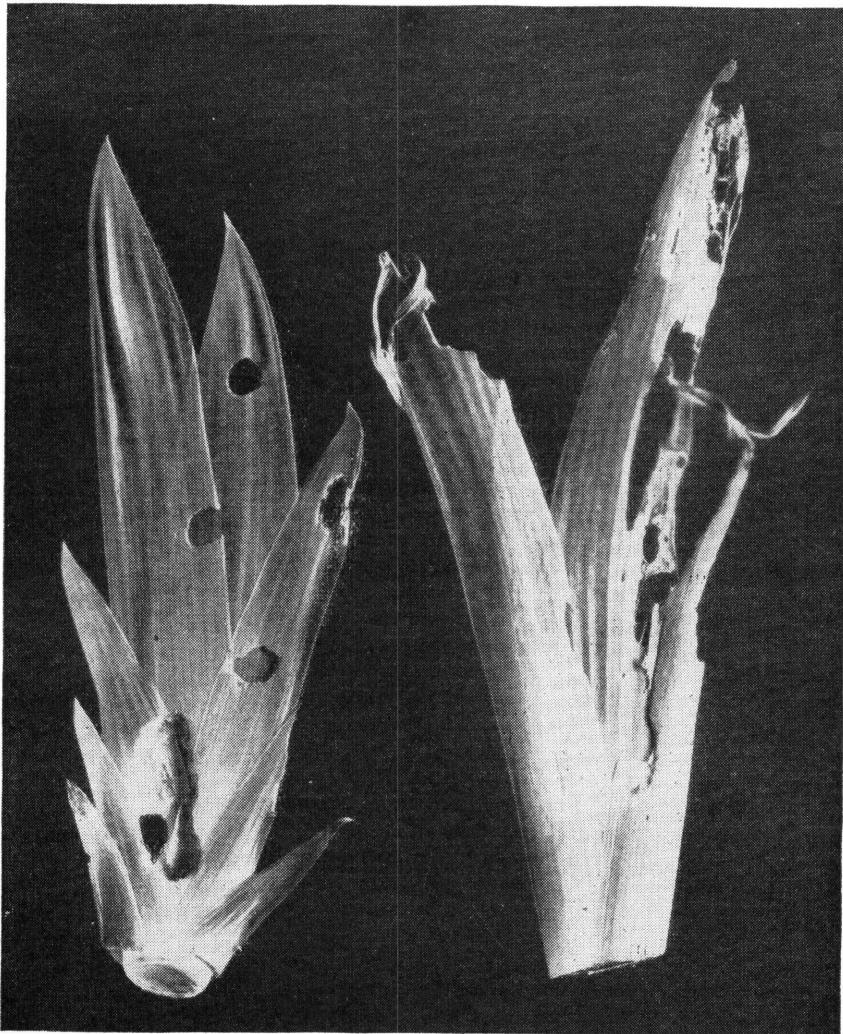


FIGURE 4.—Damage done by snails on iris. . .

It is probable that few slugs survive the winter out of doors in the colder regions, but they are able to survive in such places as drain pipes, cellars, greenhouses, storage pits, and well walls. They are said to perish quickly when exposed to temperatures below freezing. Snails seem to be more hardy. Greenhouse snails have successfully passed the winter out of doors as far north as Washington, D. C., by sheltering themselves beneath trash piles.

Soon after emerging from the eggs, the young slugs and snails begin to move about in search of food. This consists of such material as is near at hand, since they do not wander far, remaining for 4 or 5 weeks in a colony near the place where the eggs were deposited. In some of the introduced species this colonial habit persists throughout life, but the native species tend to wander farther and farther afield until the colony is broken up. The homing instinct is well developed in some slugs, each individual returning to its particular hiding place night after night, unless disturbed or unless the place becomes too dry. The route taken in returning is usually the same as that taken in going out. Snails and slugs will, if possible, avoid all dusty, dry, or sharp objects.

### LIFE HISTORY

The life history of the spotted garden slug is described herein. Its eggs are oval, translucent and light yellow, and have a tough, elastic outer membrane or shell. They are laid in masses of 25 or more in moist places, as under boards, trash, and flowerpots, in compost piles, or beneath the surface of the soil under clods or stones. The egg masses are held together by a light-colored mucilaginous substance. Eggs may be deposited in the open at any time from spring to fall. In greenhouses, cellars, or other places which are warm during the winter, slugs may oviposit at any time of the year. The incubation period varies with the temperature and moisture; at 60° to 70° F. it is about 28 days, and this is shortened at higher temperatures.

The newly hatched slug of this species, when extended, is less than one-half inch long and about one-seventh as wide as long. It is dull white, showing no color except where the dark eyestalks can be seen through the transparent mantle. In a few hours after hatching the mantle begins to darken, and in about 2 days the whole animal is darker, with three broken lines appearing, which run from the base of the mantle to the hind end of the body. The animal then changes to a mottled gray. The young slugs develop slowly, feeding very little in the younger stages, until at the end of about 30 days they have attained a length of about 1 inch. At this time the slugs are dark brown, with black spots beginning to appear. Later these spots may disappear. The young slugs grow slowly, their rate of growth depending to some extent on the abundance of food and the weather conditions. The exact time required for the animal to attain full growth is not known, but it is probably more than a year under normal conditions. When fully grown, this species may reach a length of 7 inches.

The life history of the white garden snail may be considered as fairly typical of that of other kinds of snails. The eggs are round and white and have a calcareous, or limy, shell. They are laid in a cavity hollowed out by the parent snail about 1 inch beneath the surface of the ground. From 10 to more than 200 eggs may be laid in one mass, depending on the time of year and the size of the parent. As in the case of the slugs, weather conditions control the time of incubation, but the average is about 18 to 20 days. The young snails are very small when newly emerged from the egg, and for several months they remain close to the place of hatching. They grow slowly, adding coils to the shell as they grow. Probably, as with

the slugs, more than a year is required for them to attain full size. It is known that the European species of *Helix* require 2 or 3 years.

### NATURAL ENEMIES

Among the few natural enemies of the slugs is the common toad. Most creatures hesitate to attack slugs because of the viscid slime which they secrete so copiously. Snails have a number of natural enemies, which include several species of carabid and lampyrid beetles, several species of small flies, various birds, and poultry, especially ducks.

### HOW TO CONTROL SLUGS AND SNAILS

#### HAND PICKING

If only a few slugs or snails are present, they can sometimes be controlled by hunting them out at night with a lantern or flashlight. At this time they may be found feeding or crawling about in search of food. In the daytime they can be traced to their hiding places by their trails of slime, caught, and destroyed.

#### REMOVING HIDING PLACES, KEEPING PREMISES DRY, AND EMPLOYING POULTRY

Cleanliness will accomplish much toward the control of slug and snail pests. All loose boards, bricks, stones, trash piles, manure piles, compost piles, and other places that might shelter the animals should be removed. Pointing-up basements and wells to eliminate hiding places is important. Material taken into greenhouses should be examined for slugs. Since slugs and snails are favored by dampness, keeping basements and vegetable storages as dry as possible helps to reduce losses and annoyance. In small areas ducks and chickens will sometimes clean up an infestation in a relatively short time. Ducks, especially, seem very fond of snails.

#### USING LIME OR SALT

A band of hydrated lime or air-slaked lime (builders' lime) 3 or 4 inches wide and  $\frac{1}{2}$  inch thick is said<sup>2</sup> to form an effective barrier to slugs, and probably would be equally effective against snails. This barrier is especially useful in protecting flower beds and seedbeds, when the damage is confined to the margin of the beds. When damage is more general throughout the beds, lime may be applied to the whole soil surface at the rate of 4 pounds to each 100 square yards. This is best done by means of a dust gun, but fairly satisfactory results may be obtained by shaking a thin cloth sack partly filled with lime dust over the beds. Treatment late in the afternoon gives the best results. The barrier should be renewed or the soil surface re-treated every 3 or 4 days as long as damage by slugs or snails continues. To serve its purpose, the lime should be dry at all times. If it becomes damp from any cause, it should be renewed as soon as possible. Care should be exercised not to place too heavy a deposit of lime on the plants.

Salt will kill slugs and snails if they come in contact with it.

<sup>2</sup> Tenhet, J. N., and Milam, Joe. The Black European Slug, a Pest of Tobacco Plants. U. S. Dept. Agr., Bur. Ent. and Plant Quar., E-372, [6] pp., illus. [Mimeographed.] 1936.

Since salt is capable of killing vegetation and injuring the soil, it should be used with caution. Both lime and salt act as dehydrators, causing slugs and snails to secrete slime so copiously that they dry out and die.

### USING POISONED BAITS

#### Arsenicals

A great many materials have been tried in attempts to control snails and slugs. The use of baits poisoned with an arsenical is limited, because slugs and snails are very slow to change their diet. In gardens where it is possible to use it, an arsenical bait consisting of 1 part of calcium arsenate, 16 parts of bran (by weight), and enough water to make a medium-moist mash has given over 90-percent kill of the white garden snail. The ground is first wet, then the bait is broadcast, and the area is sprinkled daily for 5 days. Addition of from 1.5 to 2.5 percent of powdered metaldehyde is said to increase the effectiveness of this bait.<sup>3</sup> Another type of bait may be prepared by using chopped-up lettuce leaves instead of the bran. Care should be exercised that poisoned bait is not consumed in harmful quantities by birds, poultry, or pet stock.

#### Metaldehyde

Metaldehyde mixed with corn meal, bran, or similar material attracts and kills all kinds of snails and slugs. A mixture consisting of 1 ounce of powdered metaldehyde and 3 pounds of wheat bran is effective under some conditions. This bait may be slightly moistened or applied dry. It appears to be most attractive if moistened and distributed late in the evening. It should not be distributed out of doors just before a rain, as it will be washed away and its effectiveness lost. When broadcast over large areas, it is applied at the rate of 40 to 50 pounds per acre. Bait machined into pellets about  $\frac{1}{16}$  inch in diameter, and broadcast at the rate of 5 to 10 pounds per acre, is more economical of labor and materials. In greenhouses it may either be broadcast or placed in many small piles along the edges of the benches. In mushroom houses it may be placed along the edges of the beds. If protected from direct watering, its effectiveness persists for about a week. When slugs or snails eat this substance, it paralyzes them, and both in greenhouses and out of doors the heat of the sun during the following day will generally kill them all. If the weather is cloudy and the humidity is continuously high, some may recover and crawl off after about 48 hours. Under such conditions both metaldehyde and calcium arsenate should be used in the bait.

Metaldehyde seems to be specific for slugs and snails, but its effectiveness against insect pests is not known, and its action on domestic animals or birds is not known definitely. It has heretofore been used in Europe as a source of heat for small camp stoves, chafing dishes, and similar equipment, as our "canned heat" is used, and its effectiveness against slugs and slugs was discovered comparatively recently by European workers.

<sup>3</sup> Lange, W. H., Jr., and MacLeod, G. F. Metaldehyde and Calcium Arsenate in Slug and Snail Baits. Jour. Econ. Ent. 34: 321-322, illus. 1941.